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The role of the Committee on Sustainable Energy and its subsidiary bodies in Supporting the 2030 Agenda on Sustainable Development: Sustainable resource management

Bridging Document between the National Standard of the People's Republic of China Classification for Petroleum Resources/Reserves (GB/T 19492-2004) and the United Nations Framework Classification for Resources

Prepared by the Mineral Resources and Reserves Evaluation Center of the Ministry of Land and Resources of the People's Republic of China in cooperation with the Technical Advisory Group of the Expert Group on Resource Classification[1]

Summary

This document provides the Bridging Document between the National Standard of the People's Republic of China Classification for Petroleum Resources/Reserves (GB/T 19492-2004) and the United Nations Framework Classification for Resources (UNFC). Bridging documents explain the relationship between UNFC and another classification system that has been endorsed by the Expert Group on Resource Classification as an Aligned System. They incorporate instructions and guidelines on how to classify estimates generated by application of that Aligned System using the UNFC Numerical

[1] This Bridging Document was developed by the Mineral Resources and Reserves Evaluation Center of the Ministry of Land and Resources of the People's Republic of China in cooperation with the Technical Advisory Group of the Expert Group on Resource Classification. Following review by the Expert Group at its eighth session, 24–28 April 2017, the Bridging Document was issued for public comment from 15 February to 15 April 2018. Development of this Bridging Document has followed the Document Approval Procedure agreed by the Expert Group at its fifth session, April 2014. The Bridging Document is presented to the Committee on Sustainable Energy at its twenty-seventh session for endorsement.

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Code". This Bridging Document compares reserves and resources by Categories of GB/T 19492-2004 to Categories and Classes of UNFC. GB/T 19492-2004 was issued by the Standardization Administration of the People's Republic of China under the General Administration of Quality Supervision, Inspection and Quarantine of the People's Republic of China on 30 April 2004, and implemented on 1 October 2004. It establishes unified guidance regarding China's principles for evaluation, auditing and reporting of reserves and resources of crude oil, natural gas and gas condensate. This Bridging Document does not affect the independent application of GB/T 19492-2004 and application of GB/T 19492-2004 does not affect any component of UNFC. In the event of any difference between the Chinese language version and any other language version, the Chinese language version shall prevail.

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I. Introduction

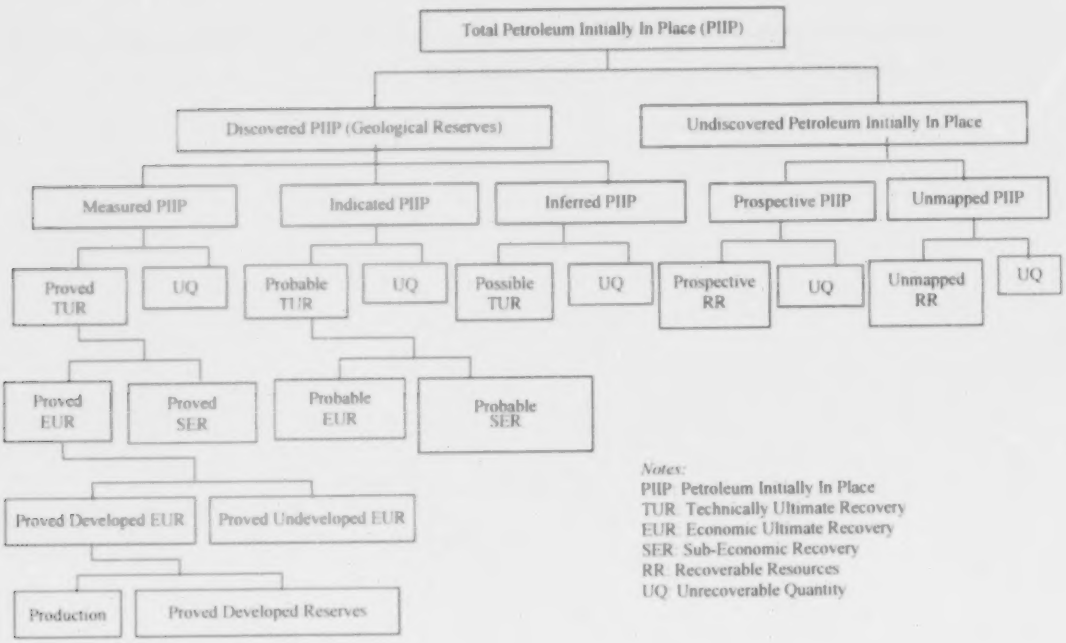
1. Bridging Documents explain the relationship between the United Nations Framework Classification for Resources (hereinafter referred to as "UNFC") and another classification system that has been endorsed by the Expert Group on Resource Classification as an Aligned System. They incorporate instructions and guidelines on how to classify estimates generated by application of that Aligned System using the UNFC Numerical Codes. The relevant Bridging Document shall be identified when reporting estimates using the UNFC Numerical Codes.

2. This document compares reserves and resources by categories of the National Standard of the People's Republic of China "Classification for Petroleum Resources/Reserves" (GB/T 19492-2004) (hereinafter referred to as "GB/T 19492-2004") with Categories and Classes of UNFC.

3. GB/T 19492-2004 was issued by the Standardization Administration of the People's Republic of China under the General Administration of Quality Supervision, Inspection and Quarantine of the People's Republic of China on 30 April 2004, and implemented on 1 October 2004. It establishes unified guidance regarding China's principles for evaluation, auditing and reporting of reserves and resources of crude oil, natural gas and gas condensate (Figure 1).

4- GB/T 19492-2004, the enforced guidelines for the reporting of oil and gas reserves to the Chinese Government, is independent of UNFC. This Bridging Document does not affect the independent application of GB/T 19492-2004. The application of GB/T 19492-2004 does not affect any component of UNFC.

Figure 1
Chinese Classification for Petroleum Resources/Reserves



5. In GB/T 19492-2004, the classification is mainly based on exploration and development phases, geological knowledge and confirmation of productivity. The classification of volumes according to GB/T 19492-2004 is divided into different classes and categories according to the vertical and horizontal axes.

6. The horizontal axis is divided into two major classes according to the status of discovery: Reserves (discovered) and Resources (undiscovered). According to the status of the asset and the geological reliability, the Geological Reserves are sub-divided further into three categories: Inferred, Indicated and Measured; Resources is sub-divided further into two categories: Prospective and Unmapped. The vertical axis is divided into four classes, based on the resources attributes: PIIP (Petroleum Initially In Place), TUR (Technically Ultimate Recovery), EUR (Economic Ultimate Recovery) and Development Status.

A. The Vertical Axis: covers four classes from top to bottom

7. First class: Volumes in place. PIIP is an abbreviation of Petroleum Initially In Place. Total Petroleum Initially In Place (PIIP) refers to the total oil and gas quantities existing initially in discovered and undiscovered accumulations which are estimated by using appropriate methods, based on the geological, geophysical and laboratory data available in different exploration and development phases.

8. Second class: Technical recoverability. TUR is an abbreviation for Technically Ultimate Recovery. These are the volumes that can technically be recovered from the reservoir, regardless of other constraints or economic criteria. Unrecoverable Quantities are abbreviated to UQ. The summation of TUR and UQ will provide the PIIP. For prospective and unmapped resources, RR replaces TUR, and it is an abbreviation for Recoverable Resources.

9. Third class: Economic viability. EUR is an abbreviation of Economic Ultimate Recovery and refers to those quantities of petroleum which are estimated, on a given date, to be economically recoverable from an accumulation, plus the quantities already produced. SER, an abbreviation of Sub-Economic Recovery, refers to the technically ultimate recovery that is determined to be sub-economic in economic evaluation, or cannot be classified as EUR with consideration to contract, enhanced recovery technology or other factors. The sum of EUR and SER will provide the TUR. Economic viability is only considered in the case when the volumes are categorized as Indicated or Measured (see paragraph 19).

10. Fourth class: Development status. For an approved project, this level provides the detailed development status of all volumes. The sum of Cumulative production, Proved Developed Reserves and Proved Undeveloped EUR is equal to the Proved EUR, maintaining the balance in the whole system. Development status is only estimated for the volumes categorized as Proved EUR (see paragraph 20).

B. The Horizontal Axis: from right to left

11. In GB/T 19492-2004, the classification focuses more on geological knowledge and technical recoverability than on economic viability. As the type of project is related to the exploration and development phases, the classification and categorization of Geological Reserves (also known as Discovered PIIP) and TUR are considered important.

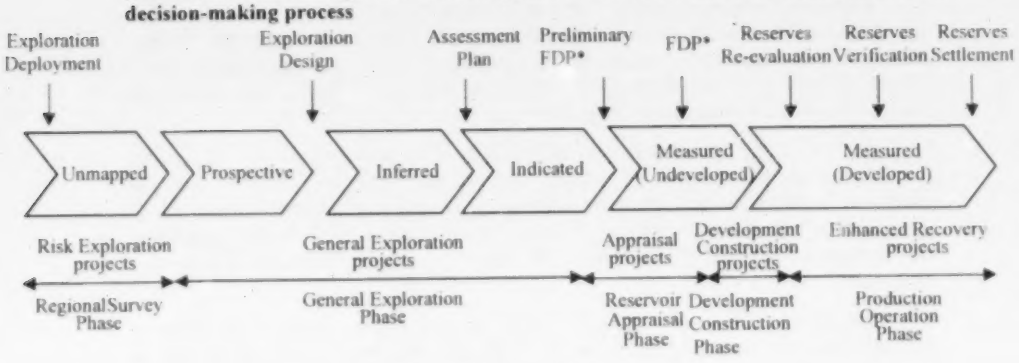
12. GB/T 19492-2004 emphasizes the overall assessment status of petroleum reservoirs. Before the discovery, the volumes are classified under the Undiscovered PIIP class. After discovery, they will be classified under Discovered PIIP (or Geological Reserves). The Discovered volumes are also classified based on the project status and the level of geological

knowledge associated with the petroleum reservoir. The Geological Reserves associated with the asset are assigned to one of three categories: Inferred, Indicated or Measured. These categories reflect the degree of geological confidence from low, moderate and high for the same reservoir in different stages of exploration and development, respectively (**Error! Reference source not found.** Figure 2):

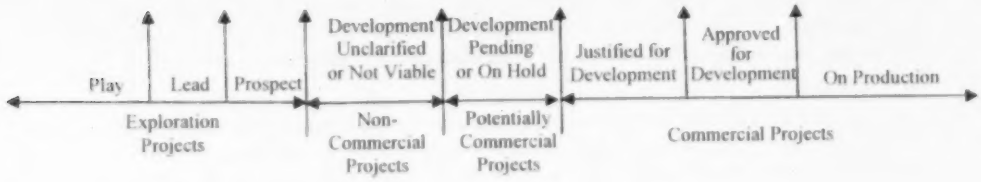
- After discovery: low geological confidence. Volumes are categorized as "Inferred". No economic evaluation is completed yet.
- During the General Exploration phase: moderate geological confidence. Volumes are categorized as "Indicated". Preliminary economic evaluations are completed.
- After the Reservoir Appraisal phase: high geological confidence. Volumes are categorized as "Measured". Detailed economic evaluations are completed.

Figure 2

Classification and Categorization correspond to the Exploration and Development phases and the decision-making process



Above: GB/T 19492-2004
Below: UNFC



Note: * FDP – Field Development Plan

C. In Place Volumes

13. Undiscovered PIIP: refers to the total quantities of oil and gas estimated in unknown accumulations based on predictions. It can be categorized as Prospective PIIP and Unmapped PIIP.

- Prospective PIIP: refers to the Total Petroleum Initially In Place in known and confirmed favourable traps or blocks (formations) adjacent to oil and/or gas reservoirs estimated by the trap method at the early stage of the General Exploration phase, through analysis and analogy of petroleum geological conditions.

- Unmapped PIIP: refers to the Petroleum Initially In Place in the prospecting basin, depression, sag, belt and other accumulations, which is estimated in the Regional Survey phase or other exploration phases, based on geological, geophysical and geochemical surveys, and regional exploratory well data. It is generally the Total Petroleum Initially In Place minus the Prospective PIIP and minus the Geological Reserves.

14. Geological Reserves (Discovered PIIP): refers to the total oil and gas quantities estimated based on seismic, drilling, well logging and test data in known reservoirs/fields after oil and gas are found by drilling. It can be categorized as Inferred PIIP, Indicated PIIP and Measured PIIP based on project status and geological knowledge (see Figure 2).

- Inferred PIIP: refers to the Geological Reserves that are estimated during the General Exploration Phase with a low level of confidence when oil and/or gas flows are obtained from a wildcat well, or the integrated interpretation indicates the probable existence of oil and/or gas layers. Further exploration will be required. The Inferred PIIP is estimated under the preconditions that: (1) the structural configurations and reservoir conditions should be preliminarily ascertained; and (2) a wildcat has obtained oil and/or gas flows or encountered oil and/or gas layers, or the reservoir/field is immediately adjacent to Measured (or Indicated) oil and/or gas zones, which show further exploration potential through comprehensive analysis.

- Indicated PIIP: refers to the Geological Reserves that are estimated with a moderate level of confidence and relative error not more than ±50% after commercial oil or gas flows are obtained from a prospecting well during the General Exploration Phase. The volumes will be categorized as Indicated PIIP under the conditions that: (1) Preliminary studies have provided information about the structural configuration, reservoir formation continuity, oil and gas distribution, reservoir type, fluid properties and productivities, etc.; (2) the level of geological confidence is moderate; and (3) it can be used as evidence for drilling reservoir appraisal wells and making conceptual design or development plans.

- Measured PIIP: refers to the Geological Reserves that have been proved economically recoverable by appraisal drilling during the Reservoir Appraisal phase. The volumes are estimated with a high level of confidence and relative error, not more than ±20%. The volumes will be categorized as Measured PIIP if: (1) the reservoir type, depositional environment, drive mechanism, fluid properties and distributions, and productivities etc. are known; (2) fluid contacts or the lowest known hydrocarbons are determined by drilling, logging and testing data or reliable pressure data; (3) reasonable well control or primary development well pattern designed in a development plan is available; and (4) all parameters have a high level of certainty. If the conditions above are met, a Final Investment Decision is expected for the development of the asset and proved EUR can be estimated.

D. Technical Recoverability

15. In the GB/T 19492-2004, "Measured" "Indicated" and "Inferred" are categories of PIIP within a reservoir based on geological confidence in a different phase. "Proved", "Probable" and "Possible" refer to the recoverable portions of Measured, Indicated and Inferred respectively. It should be noted that this terminology is NOT linked to the meanings given for "Proved", "Probable" and Possible" contained in guidelines such as the Canadian Oil and Gas Evaluation Handbook (COGEH), the Petroleum Resources Management System

(PRMS), and those provided by the United States Securities and Exchange Commission (SEC).

16. Recoverable Resources (RR): refers to the recoverable oil and gas quantities from the Undiscovered PIIP. It can be categorized as Prospective RR and Unmapped RR, for which the recovery factors are estimated by the empirical analogy method.

- Prospective RR: refers to the recoverable oil and gas quantities from the Prospective PIIP.
- Unmapped RR: refers to the recoverable oil and gas quantities from the Unmapped PIIP.

17. Technically Ultimate Recoveries (TUR) are those volumes of petroleum which are estimated theoretically or by the use of analogues to be recoverable from discovered accumulations under given technological condition.

- Possible TUR: refers to the Technically Ultimate Recovery associated with Inferred PIIP, and meeting the following requirements: (1) All requirements and maturity for the Inferred PIIP have been met; (2) The applicable technology is likely to be implemented; (3) There should be at least 10% probability that the quantities actually to be recovered in the future will equal or exceed the estimated TUR.
- Probable TUR: refers to the Technically Ultimate Recovery associated with Indicated PIIP, meeting the following requirements: (1) All requirements and maturity for the Indicated PIIP have been met; (2) The applicable technology is presumed to be probably implemented; (3) The feasibility studies show the development is above sub-economic.
- Proved TUR: refers to the Technically Ultimate Recovery associated with Measured PIIP, meeting the following requirements: (1) All requirements and maturity for the Measured PIIP have been met; (2) The technology (including oil and/or gas production technology and enhanced recovery technology) has been demonstrated by pilot projects, or the recovery technology has been used successfully in analogous reservoirs; (3) The conceptual design or development plan is available, and the development has been implemented or will be implemented in the near future; (4) The feasibility study has been carried out based on recent average prices and costs.

18. Unrecoverable Quantities (UQ): refers to the difference between the PIIP and the Recoverable Quantity (RQ). In GB/T 19492-2004, the UQ can be divided into five categories, corresponding to the Unmapped, Prospective, Inferred, Indicated and Measured categories respectively.

E. Economic Ultimate Recoveries (EUR)

19. Economic Ultimate Recoveries (EUR): are those quantities of petroleum which are anticipated to be economically recoverable from discovered accumulations under existing economic conditions (such as prices, costs, etc.) or economic conditions defined by relevant contract, and under current executed or planned to be established technical operating conditions. They are divided into four categories: Probable EUR, Probable SER, Proved EUR and Proved SER.

- Probable EUR: refers to the economic ultimate recovery, associated with Indicated PIIP, meeting the following requirements: (1) All requirements and maturity for the Indicated PIIP have been met; (2) The preliminary feasibility studies show the

development is economic; (3) There should be at least 50% probability that the quantities recovered in the future will equal or exceed the estimated EUR.

- Probable SER: refers to the difference between the Probable TUR and the Probable EUR.

- Proved EUR: refers to the economic ultimate recovery, associated with Measured PIIP, meeting the following requirements: (1) All requirements and maturity for the Measured PIIP have been met; (2) The applicable technology has been implemented, or the applicable technology has been demonstrated by pilot projects and is virtually certain to be implemented, or the applicable technology has been applied successfully in analogous reservoirs in the same field and is virtually certain to be implemented; (3) Development plan is available, and it will be carried out in the near future; (4) Export facilities are or will be made available. For gas, there should be an existing gas pipeline or gas pipeline construction agreement, as well as a sales contract or agreement; (5) The reserve boundaries are based on the fluid contacts confirmed by drilling or reliable pressure test data, or the lowest known hydrocarbons encountered in the well, and within the boundaries of reasonable well control; (6) The economic productivity has been demonstrated by the actual production or by conclusive test, or the productivity in the formation is confirmed by analogy with offset wells or a similar formation in the same well which has indicated economic production; (7) Feasibility studies show the development is economic based on prices and costs stipulated in the contracts or agreements and relevant economic conditions; and (8) There should be at least 80% probability that the quantities actually recovered in the future will equal or exceed the estimated EUR.

- Proved SER: refers to the difference between the Proved TUR and the Proved EUR, and includes two parts: (1) Those Proved TUR for which the feasibility studies indicate the development is sub-economic; (2) Those Proved TUR that are anticipated to be economic, but for which uncertainties in contractual and/or enhanced recovery technologies preclude such volumes being categorized as Proved EUR.

F. Development Status

20. Proved EUR is further divided into Proved Developed EUR and Proved Undeveloped EUR. Proved Developed Reserves is the difference between the Proved Developed EUR minus the Cumulative Production.

- Proved Developed EUR: refers to the Recoverable Reserves that have been put into development after the completion of well drilling and the installation of associated facilities based on an approved oil and/or gas reservoir development plan. In the case of enhanced recovery technology (e.g. water flooding), the volumes are also categorized as Proved Developed EUR when the facilities required have been completed and put into services. The Proved Developed EUR should be updated regularly during the development and production.

- Proved Undeveloped EUR: refers to the economic ultimate recovery in the oil and/or gas reservoirs/fields where the reservoir appraisal has been completed, or a production pilot has been conducted, but the development wells have not been drilled yet.

21. To estimate Recoverable Reserves with GB/T 19492-2004, TUR is calculated first, and then economic evaluation is conducted with respect to Proved TUR and/or Probable TUR to distinguish EUR and SER. Economic evaluation is not made for Possible TUR. The economic evaluation may demonstrate two cases as follows:

- If the reservoir development project is economic, the SER equals the TUR minus the EUR;
- If the reservoir development project is sub-economic, the SER equals the TUR.

II. Direct mapping of Categories and Sub-categories

A. Application of the G Axis (confidence in the geological knowledge and potential recoverability of the quantities)

22. In UNFC, the recoverable quantities and additional quantities in place within known (discovered) deposits are categorized into high, moderate and low levels of confidence, represented by G1, G2 and G3 respectively. The estimated quantities associated with deposits yet to be discovered (project in exploration stage) are categorized as G4.

23. In GB/T 19492-2004, the Geological Reserves are mainly estimated by the deterministic volumetric method, with the reservoir as the basic unit. Reserves are divided into three categories, i.e. Inferred, Indicated and Measured, in an ascending order of the overall status of reservoirs in the exploration and development phases and the geological knowledge (see Figure 2). In GB/T 19492-2004, each reservoir has an independent category of geological reserves, directly associated with its own TUR and EUR. The Measured category includes Measured PIIP, Proved TUR, Proved EUR, Proved SER and Measured UQ, all of which have a high level of confidence (G1). The Indicated category includes Indicated PIIP, Probable TUR, Probable EUR, Probable SER and Indicated UQ, all of which have a moderate level of confidence (G1+G2). The Inferred category includes Inferred PIIP, Possible TUR and Inferred UQ, all of which have a low level of confidence (G1+G2+G3). There is no category of initially in place volumes and TUR in UNFC. For completeness of GB/T 19492-2004, categories and classes of PIIP and recoverable quantities are shown in Figure 3.

24. With regard to Exploration Projects, while UNFC provides the option to sub-categorize G4.1, G4.2, and G4.3 based on geological uncertainty, under GB/T 19492-2004 these categories refer to G4 without sub-categorization; when used alone, it reflects the best estimate.

Figure 3

Comparison of GB/T 19492-2004 and UNFC on the Confidence in Geological Knowledge and Potential Recoverability of the Quantities

<table>
<tr><td colspan="7">GB/T 19492-2004 Class/Category</td><td>UNFC Category</td></tr>
<tr><td rowspan="8">Discovered</td><td rowspan="4">Measured</td><td rowspan="4">PIIP</td><td rowspan="4">Proved TUR</td><td rowspan="2">Proved EUR</td><td>Proved Developed EUR</td><td>Cumulative Production</td><td>Extracted Production</td></tr>
<tr><td>Proved Developed EUR</td><td>Proved Developed Reserves</td><td rowspan="3">G1</td></tr>
<tr><td colspan="2">Proved Underdeveloped EUR</td></tr>
<tr><td colspan="3">Proved SER</td></tr>
<tr><td rowspan="3">Indicated</td><td rowspan="3">PIIP</td><td rowspan="3">Probable TUR</td><td colspan="3">UQ</td></tr>
<tr><td colspan="3">Probable EUR</td><td rowspan="2">G1+G2</td></tr>
<tr><td colspan="3">Probable SER</td></tr>
<tr><td>Inferred</td><td>PIIP</td><td colspan="4">UQ</td><td rowspan="2">G1+G2+G3</td></tr>
<tr><td rowspan="4">Undiscovered</td><td rowspan="2">Prospective</td><td rowspan="2">PIIP</td><td colspan="4">Possible TUR</td></tr>
<tr><td colspan="4">UQ</td></tr>
<tr><td rowspan="2">Unmapped</td><td rowspan="2">PIIP</td><td colspan="4">RR</td><td rowspan="2">G4</td></tr>
<tr><td colspan="4">UQ</td></tr>
</table>

B. Detailed mapping of the E and F Axes

25. While the G Axis (confidence in the geological knowledge and potential recoverability of the quantities) expresses the uncertainty and the confidence levels within each reservoir, the detailed matrix used for the mapping of the E Axis (economic and social viability of the project) and the F Axis (field project status and its feasibility) can be seen in Figure 4. The keys and colour code are provided in Figure 5.

Figure 4
Mapping of the E-F Matrix to GB/T 19492-2004 Classes and Categories

	F1.1	F1.2	F1.3	F2.1	F2.2	F2.3	F3.1	F3.2	F3.3	F4
E1.1			3	4						
E1.2			3							
E2	4	4	4	4	5					
E3.1	12	12	12	12	12	12				
E3.2								9	10	
E3.3										11

Figure 5
Mapping of the E-F Matrix to GB/T 19492-2004. Code and Numeric Key

Class	*Sub-class*	*Code*	*GB/T 19492-2004 Class and Category*
Commercial Projects	On Production		Proved Developed Reserves
	Approved for Development	2	Proved Undeveloped EUR
	Justified for Development	3	Proved Undeveloped EUR
Potentially Commercial Projects	Development Pending	4	Proved SER, Probable EUR, Probable SER, Possible TUR
	Development on Hold	5	Proved SER, Probable EUR, Probable SER, Possible TUR
Non-Commercial Projects	Development Unclarified		Proved SER, Probable SER, Possible TUR
	Development Not Viable		Proved SER, Probable SER, Possible TUR
Additional Quantities in Place		11	Measured, Indicated and Inferred UQs
Exploration Projects	Prospect		Prospective RR
	Lead	9	
	Play	10	Unmapped RR
Additional Quantities in Place		11	Prospective and Unmapped UQs
Produced Not Sold		12	

26. The simplified version shown in **Error! Reference source not found.** shows the mapping without optional sub-classes. Note that the E and F Categories set the "minimum" standards for UNFC classes. For example, a Potentially Commercial Project must be at least E2 and F2, but it could also be E2F1.

Figure 6
Mapping Classes and Categories between GB/T 19492-2004 and UNFC

GB/T 19492-2004 Category / Class		*UNFC "minimum" Category*			*UNFC Class*
Discovered	Proved Developed Reserves, Proved Undeveloped EUR	G1	E1	F1	Commercial Projects
	Proved SER	G1	E2	F2	Potentially Commercial Projects
	Probable EUR, Probable SER	G1+G2			
	Possible TUR	G1+G2+G3			
	Proved SER	G1	E3	F2	Non-Commercial Projects
	Probable SER	G1+G2			
	Possible TUR	G1+G2+G3			
	UQ (Measured)	G1	E3	F4	Additional Quantities in Place
	UQ (Indicated)	G1+G2			
	UQ (Inferred)	G1+G2+G3			
Undiscovered	Prospective RR, Unmapped RR	G4	E3	F3	Exploration Projects
	UQ (Prospective, Unmapped)	G4	E3	F4	Additional Quantities in Place

C. Exploration projects

27. In **Error! Reference source not found.**, four cells (8, 9, 10 and 11) in the E-F matrix show the mapping of undiscovered quantities in GB/T 19492-2004. The categories are associated with exploration projects at different stages of maturity. In UNFC, the G4 category is used for the Exploration Projects. While UNFC provides the option to expand G4 to account for uncertainty in recoverable quantities (G4.1, G4.2 and G4.3), GB/T 19492-2004 does not provide an uncertainty range, and only the best estimate is provided.

D. Additional Quantities in Place

28. Additional Quantities in Place under UNFC correspond to quantities of hydrocarbons that are currently assessed as technically un-recoverable for any class in GB/T 19492-2004. In UNFC, these volumes are classified as E3.3 F4.

III. Mapping GB/T 19492-2004 Categories to Multiple UNFC Sub-categories

29. As UNFC contains more granularity than GB/T 19492-2004, it is expected that there will be instances where a single GB/T 19492-2004 category could reflect a combination of several UNFC sub-categories. This is illustrated in Figure 4.

30. UNFC is based on three axes (E, F and G) and allows each project to be classified according to the relevant maturity. GB/T 19492-2004 does not provide a full definition of sub-classes according to a project's maturity. However, the division of classes and categories is based on the same principles: the levels of geological uncertainty and project status (E and F Axes) are closely linked and are expressed on the horizontal axis of Figure 2. Economic evaluations are included in the vertical axis of Figure 1, and mapped to the E axis. Therefore, it is possible to establish a relationship between GB/T 19492-2004 classes and categories and UNFC classes and sub-classes (Figure 4).

31. In UNFC, four classes are used for "known accumulations": "Commercial Projects", "Potentially Commercial Projects", "Non-Commercial Projects" and "Additional Quantities in Place". Previously extracted sales production quantities are not included, while non-sales production quantities are referred to as Code 12 in Figure 5.

A. Commercial projects sub-categorization

32. The Proved Developed Reserves and Proved Undeveloped EUR in GB/T 19492-2004 map to the "Commercial projects" class in UNFC. The development projects associated with the two classes of recoverable reserves are based on the approved, or economically justified, development plans. These quantities are sub-categorized as E1.1 in UNFC.

33. Proved Developed Reserves maps directly to the UNFC sub-class "On Production" (F1.1). The Proved Undeveloped EUR, with its development plan approved, maps to the UNFC sub-class "Approved for Development" (F1.2). The "Approved for Development" project requires that the capital funds have been committed and the development project is underway.

34. Proved Undeveloped EUR for which the development feasibility study has been conducted but the development plan has not been approved corresponds to the UNFC sub-class "Justified for Development" (F1.3). The "Justified for Development" project requires that a sufficiently detailed study has been conducted and the implementation of development project demonstrates the feasibility of development. The project has been demonstrated to be technically feasible, and there must be a reasonable expectation that all necessary approvals/contracts for the project to proceed to development will be forthcoming.

35. Quantities for which extraction and sales become non-profitable on the basis of current market conditions and realistic assumptions of future market conditions, but are made viable economically through government subsidies and/or other considerations, are categorized as E1.2 in UNFC. Similarly, the Proved Developed Reserves and Proved Undeveloped EUR map to E1.2.

36. Associated quantities derived from Proved Developed Reserves, Proved Undeveloped EUR, Proved SER, Probable EUR, Probable SER, and Possible TUR that are forecast to be extracted, but will not be available for sale will be linked to Sub-category E3.1 in UNFC. The project sub-category (F axis) will be the same as for associated quantities being extracted and sold. The level of geological uncertainty is also reflected in the project uncertainty.

B. Potentially Commercial and Non-Commercial Projects Sub-categorization

37. The Proved SER, Probable EUR, Probable SER and Possible TUR in GB/T 19492-2004 correspond to the UNFC sub-class "Potentially Commercial Projects". These four classes of recoverable reserves are reasonably expected to become commercially recoverable through oil price rise or change of other economic parameters, technical advancement or

improvement of other conditions, thus they can be assigned to E1 and E2 in UNFC. They mainly involve the following three types of projects:

- Projects that contain Proved SER associated with Proved EUR by detail development feasibility study, after the completion of Reservoir Appraisal phase;
- Projects that are demonstrated by the preliminary development feasibility study to contain Probable EUR and Probable SER above the threshold of marginal economics, in latter stage of General Exploration phase;
- Projects that contain Possible TUR, after the oil and/or gas has been discovered, and where the potential for upgrading has been established and the evaluation activities for upgrading are in progress.

38. During the General Exploration phase, the Possible TUR and Probable SER in GB/T 19492-2004 may be classified as "Non-Commercial Projects" in UNFC. Those are referred to as Sub-category E3 in UNFC. In due time, the economic condition may be updated based on new information. UNFC categories will include either: reasonable prospects for economic extraction and sale in the foreseeable future (E2), economic viability cannot be determined due to insufficient information (E3.2), or it is currently considered that there are no reasonable prospects in the foreseeable future for economic extraction and sale (E3.3), on the basis of realistic assumptions of future market conditions.

39. With regard to project maturity, there are either project activities ongoing to justify development in the foreseeable future (F2.1), or project activities are on hold (F2.2), or there are no current plans to develop or acquire additional data due to limited potential (F2.3).

40. Mapping to the UNFC Categories and Sub-categories is based on the following principles:

- Development Pending projects must, as a minimum, satisfy the definitions of both F2.1 and E2. A project that meets all technical requirements but does not meet the current economic threshold (no approved Development Plan) can be referred to as F1.3. A project with unresolved technical feasibility issues is referred to as F2.1, but if there are no doubts about commercial viability, it could still satisfy the definition of E1.1.
- Development On Hold projects are similar to Development Pending projects, but their progress in commerciality is constrained by activities which may be controlled by or outside the control of the evaluator. Projects on Hold are categorized as F2.2 to reflect the chance of commerciality but taking into account the current lack of activity progress.
- Development Unclarified projects are those where there is currently an insufficient basis for concluding that there are reasonable prospects for eventual economic extraction. This is generally caused by lack of data for making an assessment, or by evaluation being at an early stage. The projects are sub-categorized as E3.2 and as F1.3, F2.1 or F2.2 based on the level of technical maturity.
- Development Not Viable projects are potentially technically feasible projects (based on existing technology or technology currently under development), but they have been assessed as being of insufficient potential to warrant any further data acquisition activities or any direct efforts for eliminating commercial contingencies at the moment. In such cases, it can be helpful to identify and record these quantities as part of a portfolio so that in the event of a major change in commercial conditions it is possible to re-evaluate their potential for commercial development. These projects are considered to have insufficient potential for possible commercial development in the foreseeable future and are therefore always referred to as the

E3.3 sub-category in UNFC. Typically, these projects will not be technically mature due to the lack of potential and can be subcategorized as F2.3. However, there can be circumstances where, for example, the project has been improved to F1.3 and the commercial circumstances changed significantly.

41. The Probable EUR and Possible TUR in GB/T 19492-2004, for which the reservoir appraisal is underway and the economics are clarified, can be mapped to E1.1F2.1, and the Probable SER associated with Probable EUR is mapped to E2F2.1 or E3F2.1. For a project that is uneconomic currently due to uncontrollable factors, such as a drop in oil and gas prices, Proved SER could be mapped to E2F1.1 if the production of the reservoir has started or to E2F1.2 if the development plan for the project has been approved or is being implemented. The Proved SER estimated is mapped to E2F1.3 if the development plan for the project has not been approved.

42. In the case where there are reasonable prospects for economic extraction and sale in the foreseeable future (E2), but project implementation is on hold, the Proved SER that is estimated from the completion of Reservoir Appraisal phase, and the Probable EUR, Probable SER and Possible TUR that are estimated during General Exploration phase are mapped to E2F2.2 "Development On Hold" in UNFC.

43. The Proved SER and Probable SER that are lower than the threshold of marginal economics, and the Possible TUR with its economics to be determined in GB/T 19492-2004, are mapped to sub-classes of the UNFC "Non-commercial Projects". In the case where the economic viability of their extraction cannot be determined due to insufficient information (sub-category E3.2), these categories of reserves should be mapped to the sub-class of "Development Unclarified". They can be mapped to one of the categories F1.3, F2.1 and F2.2 in UNFC. The Proved SER for which the reservoir appraisal is completed, and it is technically feasible is mapped to F1.3. The Probable SER and Possible TUR for which plans are available for new data acquisition are mapped to F2.1; if the appraisal is delayed, both categories are mapped to F2.2. If it is considered, based on realistic assumptions of future market conditions, that there are no reasonable prospects for economic extraction of reserves of these categories in the foreseeable future (sub-category E3.3), these categories of reserves are mapped to sub-class "Development Not Viable".

44. In the E-F matrix, E3.1 represents the non-sales production quantities and is expressed as a numeric symbol – 12. It is not defined in GB/T 19492-2004 but included in the category of EUR. This is different from UNFC (see paragraph 51 for details).

IV. Mapping of the Exploration and Development Phases in GB/T 19492-2004 to UNFC Classes

45. In GB/T 19492-2004, the classification is mainly associated with the exploration and development phases, rather than project maturities directly. To some extent, this classification in GB/T 19492-2004 is in line with the project classification in UNFC, with the mapping relationship as shown in Figure 7.

Figure 7
Mapping of Exploration and Development Phases in GB/T 19492-2004 to Classes/Sub-classes in UNFC

GB/T 19492-2004			*UNFC*	
Reserves and Resources Class and Classification of Phases/Projects			Class	Sub-class
Discovered	Measured (Developed)	Production Operation Phase / Enhanced Recovery Projects	Commercial Projects	On Production
	Measured (Undeveloped)	Development Construction Phase / Development Construction Projects		Approved for Development
		Reservoir Appraisal Phase / Appraisal Projects		Justified for Development
	Indicated	General Exploration Phase / General Exploration Projects	Potentially Commercial Projects	Development Pending or On Hold
	Inferred		Non-Commercial Projects	Development Unclarified or Not Viable
Undiscovered	Prospective		Exploration Projects	Prospect
				Lead
	Unmapped	Regional Survey Phase / Risk Exploration Projects		Play

46. Note that at the Reservoir Appraisal phase there is already a good understanding of the reservoir and the development plan has been identified. However, some details of the design have not yet been finalized, and the development plan has not yet been approved.

47. While the project maturity in UNFC determines the commerciality of Recoverable Quantities, the classification of exploration and development phases in GB/T 19492-2004 determines the classes of reserves and resources. When the exploration and development phases of projects take place, their commercial maturity evolves, and the confidence and commercial levels of the associated reserves and resources improve. In GB/T 19492-2004, the Regional Survey phase is equivalent to risked exploration projects, the General Exploration phase is linked to general exploration projects, the Reservoir Appraisal phase corresponds to reservoir appraisal projects, the Development Construction phase to development projects, and the Production Operation phase mainly to enhanced recovery projects; they have mapping relationships with the classes and sub-classes in UNFC.

48. The appraisal projects, development construction projects and enhanced recovery projects are mapped to the "Commercial Projects" in UNFC. The enhanced recovery projects include infill wells, water (steam) injection, gas injection and polymer injection, so they are mapped to the sub-class of "On Production" in UNFC. The development construction projects are equivalent to the Proved Undeveloped reserves for which the development plan has been approved and/or the production capacity is in construction, so they are mapped to the sub-class of "Approved for Development" in UNFC. The final results of reservoir appraisal projects are Measured (undeveloped) reserves which correspond to the completion of preparing the development plan. These projects are mapped to the sub-class of "Justified For Development" under the "Commercial Projects" in UNFC.

49. The general exploration projects are mapped to "Potentially Commercial Projects", "Non-Commercial Projects" and "Exploration Projects" in UNFC. The Indicated PIIP, Inferred PIIP and Prospective PIIP are derived from the general exploration projects. The

Indicated PIIP is mainly mapped to the sub-class of "Development Pending" or "Development On Hold" under "Potentially Commercial Projects" in UNFC. The Inferred PIIP is mainly mapped to the sub-class of "Development Unclarified" or "Development Not Viable" under "Non-Commercial Projects" in UNFC. The Prospective PIIP is mapped to the sub-classes of "Prospect" and "Lead" under the "Exploration Projects" in UNFC.

50. The risk exploration projects are mapped to the sub-class of "Play" under the "Exploration Projects" in UNFC. The Unmapped PIIP can be obtained from the risk exploration projects.

V. Undefined and Unclassified Quantities in GB/T 19492-2004

51. As noted above, UNFC specifies that all non-sales quantities (lease fuel, flare and losses) may be separately identified and documented in addition to sales quantities. When needed to differentiate lease fuel and flare and losses within UNFC, quantities of each non-sales type should be accounted as a different product type (see UNFC Generic Specification D) and reported separately. Non-sales quantities are not defined and classified in GB/T 19492-2004.